Twin Boundaries in Superconducting YBCO: Their energy & dependence on Processing Parameters

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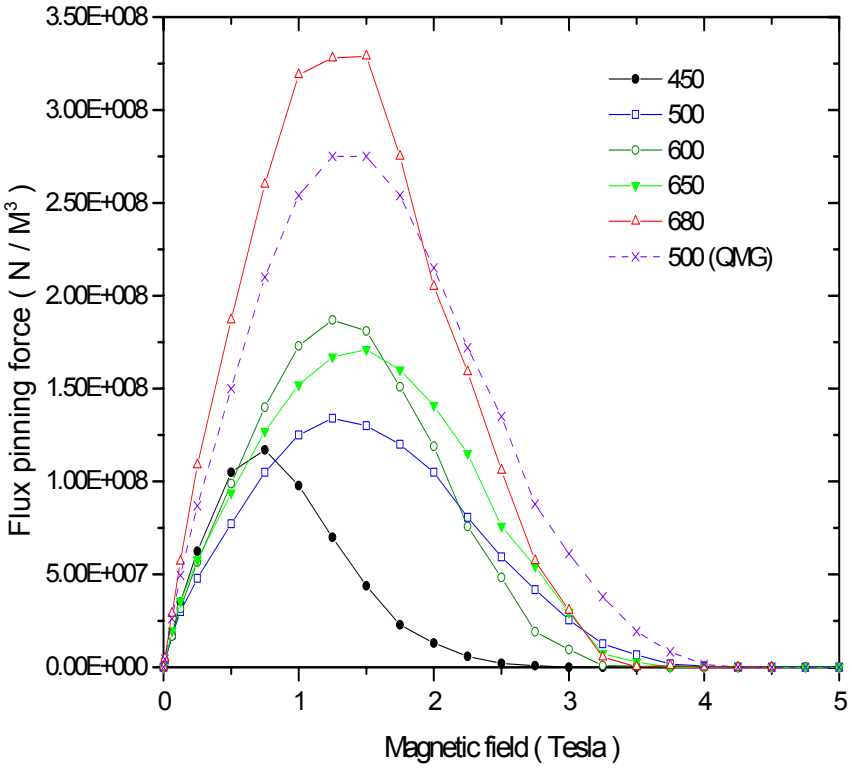
Twin boundaries, being strong magnetic-flux pinning centers, are being engineered to appear in high density to improve superconducting critical current. To do so, the boundary energy is measured by two methods to yield its entropy and enthalpy as 0.24 mJ/Km^2 and 246 mJ/m^2, respectively. The positive entropy is exploited to refine twin by increasing annealing temperature with a concomitant increase of the critical current density, the pinning force and the field at maximum pinning. Twin spacing reduces to 54 nm as the annealing temperature increases to 680^{o}C with a high pinning-force i.e. 3.4 x 10^8 N/m^3 at 77K and 1T. We have also substituted yttrium by rare earth elements in the 123 films to alter twin structure. Critical temperatures are being correlated with the rare earth ionic radii.



Education:

Three undergraduates (*Mahnaz Milani-Baladi, Johnny Lin, & Sumesh Bhaskaran*), three graduate students (*O. Jongprateep and Josh Hao-Yung Chao and Joan M Raitano*), and one post-doc (*Feng Zhang)* have contributed to this project.

Outreach: Under MRSEC, SWC has led a program bringing Columbia Students and the excitement of materials to New York City public schools to promote materials and technology since 1999. Roughly, 700 NYC students per year have seen our exciting demonstrations. See details and video at http://www.cise.columbia.edu/mrsec/education_mrsec.htm